

Monitoring and Analysis of Weekday Bus-lane policy on Gyeongbu Expressway

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I . Introduction

1. Background and objectives

The traffic volume of South Korea has risen rapidly since 1990, but road capacity failed to meet those skyrocketing demand. Thus, we are witnessing frequent traffic delays and traffic jams. Currently, the traffic volume of the highway connecting the Seoul metropolitan area with Gyeonggi province is rising annually due to the development of new residential districts and cities. However, the traffic volume of the highway connecting Seoul and Busan, so called Gyeongbu Expressway, has risen too much to call it as a highway. According to the data showing the annual traffic volume of Gyeonggi province, we can see that the traffic volume has been skyrocketed since it was 121.349(Unit : a thousand cars) in 1992.

The ministry of land, transport, and maritime designated a buy-only lane in the 44.8Km-long section from the southern part of Hannam bridge of Han River to Osan IC and has operated the bus-only lane system since July, 2008. This system aims at vitalizing public transportation usage as well as decreasing the demand for cars to lay a firm foundation for green growth and to reduce social costs. However, there is no specific study or data focusing on the effectiveness of this system. Therefore, this study compares and analyzes the influence of the Weekday Bus-lane policy on the Gyeongbu expressway objectively. At the same time, it monitors the traffic volume and traffic condition of the expressway, so that the many related organizations can use these data to establish related policies in the future.

2. Methods

This study reviewed related papers on the bus-only lane policy and monitored the change of the traffic condition after implementing the policy. It compared the traffic volume at Seoul TG, East Seoul TG, and West Seoul TG in 2007 and 2008. To identify how the traffic pattern changed after the implementation of the bus-only lane policy, it compared the rate of monthly traffic volume change, the traffic volume of passenger cars, and the number of bus passengers in the first half of 2007 and 2008 with that in the second half of 2007 and 2008. Also, traffic condition was monitored through CCTV data collected in the Gyeongbu expressway. Based on the comprehensive data collected by Korea Expressway Corporation, the rate of traffic jams and traffic delays in the section with bus-only lanes were calculated.

II . Review of previous studies

1. The definition of a bus-only lane in Gyeongbu expressway

The bus-only lane of Gyeongbu expressway is similar to HOV (High occupancy vehicle) lanes of foreign countries. Cars with a capacity of 9people and light-duty vehicles are also allowed to use the bus-only lane. Construction and designation of bus-only lanes need relatively short period of time and less money than other methods to ease traffic jams. Also the bus-only lane policy encourages people to use public transportation more. As a result, we can use roads more efficiently as well as ease severe traffic jams. At the same time, we can shorten the driving time and reduce driving costs with this system, so that total socio-economic cost of transportation can be cut.

The Road Traffic Act is the legal background of the designation of bus-only lanes in Korea. According to the 61st Article of the Road Traffic Act, Commissioner General can designate an exclusive lane including bus-only lanes in expressways when it is needed to maintain smooth traffic flow in expressways. Other categories of possible exclusive lanes are listed in the executive order of the Road Traffic Act.

2. History of the bus-only lane of Gyeongbu expressway

Bus-only lanes in the Gyeongbu expressway have been temporarily operated in a section between Yangjae and Shintanjin since July, 1994 to ease severe traffic jams during holiday seasons. After that, Weekday bus-only lane policy was implemented in a section between Suwon IC and Seocho IC as a pilot project in September, 2003 for a month. The lane was also allowed to car with 9-passenger capacity when there were more than 6people in the car. During morning rush hours, the bus-only lane was operated from 7 to 9 to Seoul and during evening rush hours, the lane was operated from 6 to 8 to Busan. However, after expanding the road connecting Hannam Bridge with Banpo IC, the bus-only lane was abolished due to the need for more feasibility studies. From the July 1, 2008, the ministry of land, transport, and maritime, the Seoul metropolitan government and the police agency temporarily implemented a weekday bus-only lane policy for 3month in an section between Osan and Hannam bridge to encourage people to use public transportation more when oil prices are going higher and higher and to shorten the commuting time for citizens living in the southern part of Seoul. From October, 2008, the system was officially implemented and the operating time of the system is from 7 to 9 in the morning.

III. Monitoring Analysis

1. Changes of the traffic volume

1) Comparison of traffic volume change in terms of time and location

This study compared the traffic volume change in the Seoul TG according to the time to find out how much the weekday bus-only lane policy affects traffic volumes. At the same time, to figure out the traffic volume of the road which Gyeongbu expressway users can detour, we also compared traffic volume change in the Seohaean expressway West Seoul TG and Jungbu highway East Seoul TG. To analyze them based on time, we also used daily average traffic volume of those roads and the monthly average of traffic volume is shown in the table 1 and picture 1.

Table 1. Average monthly volume of 2007 and 2008 (unit : veh/day)

	Seoul TG		West Seoul TG		East Seoul TG	
	2007	2008	2007	2008	2007	2008
Jan	200,465	200,310	156,696	162,022	112,962	114,032
Feb	205,856	208,281	166,085	171,959	126,278	122,606
Mar	210,593	214,688	164,616	174,581	120,400	122,436
Apr	217,976	217,434	171,354	179,146	128,994	129,690
May	218,089	218,432	171,892	180,130	133,238	131,436
Jun	214,295	210,608	172,671	175,672	130,649	122,851
Jul	212,699	196,517	170,376	175,782	129,274	125,371
Aug	215,738	203,169	173,669	185,231	139,533	140,189
Sep	218,058	203,131	174,814	183,474	134,055	132,838
Oct	221,016	194,810	176,403	186,040	130,433	132,860
Nov	218,907	191,633	175,365	185,680	131,177	132,490
Dec	208,615	183,674	167,579	175,572	123,395	119,767
Total	2,562,307	2,251,054	2,041,520	1,949,609	1,540,388	1,394,076
Ave.	213,526	204,641	170,127	177,237	128,366	126,734

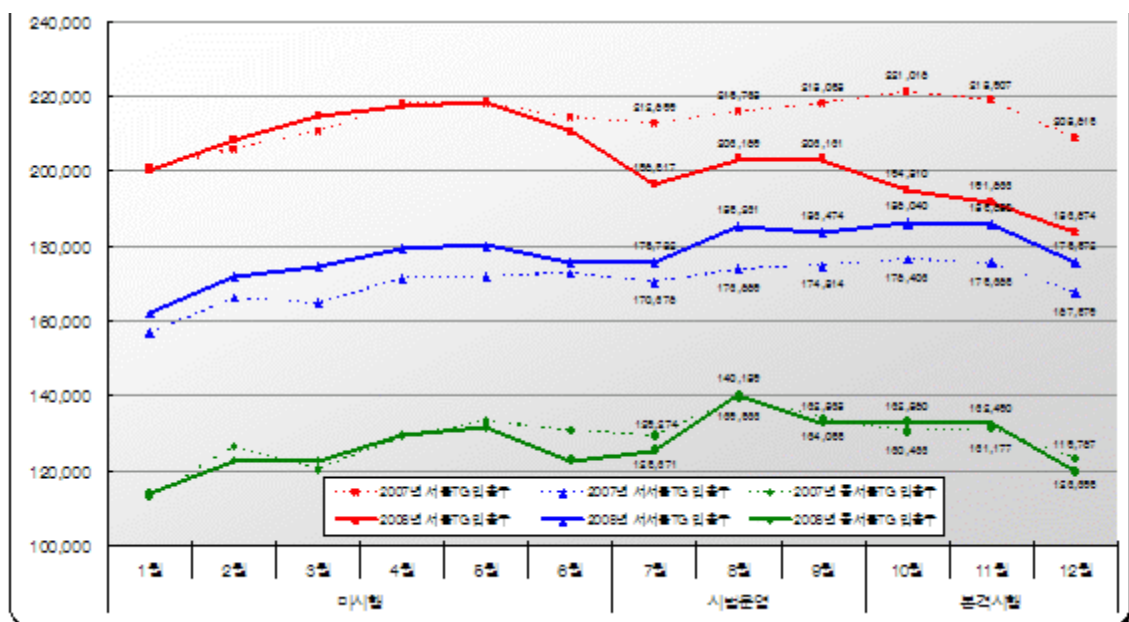


Figure 1. Comparison of average monthly volume from 2007 to 2008

According to the comparison of daily average traffic volume of each month in 2007 and 2008, the traffic volume change of the expressway was notable in the Seoul TG, followed by West Seoul TG, and East Seoul TG. In the case of Seoul TG, the traffic volume was all around the same from 2007 to May, 2008 but from June, the traffic volume of it started to decrease. In the case of West Seoul TG, the average traffic volume of

2008 increased compared to that of 2007 and in the case of East Seoul TG, the traffic volume of 2 years was similar except June, 2008.

What grabs our attention is the drop of the traffic volume in June, 2008. The main reason behind it was skyrocketing oil prices when we start to implement weekday bus-only lane policy. Due to high oil prices, the traffic volume of Seoul TG, and that of East Seoul TG in June, 2008, decreased from the previous year. The traffic volume of West Seoul TG was also decreased but still higher than that of June, 2007. After August, 2008, the traffic volume of West Seoul TG increased from the previous year but that of Seoul TG decreased due to the implementation of Weekday bus-only lane policy. After October, 2008, when the weekday bus-only lane system was officially implemented, the traffic volume rapidly decreased. However, the traffic volume of the same section increased in August and September due to the summer vacation season but was still lower than that of previous year.

According to the analysis, the traffic volume of Gyeongbu expressway was proved to be decreased after the implementation of Weekday bus-only lane policy. However, it is hard to say that people used public transportation more or many drivers detoured to another roads. However, given that the traffic volume also decreased by high oil prices, some amount of traffic volume of Seohaean Expressway or Jungbu Expressway might be transferred to other roads.

2) Analysis of traffic flow pattern

We took a look at the change of traffic volume at the TG of each expressway but it was hard to make a clear view on the change of traffic volume after conducting Weekday bus-only lane policy in the Gyeongbu expressway. Therefore, based on the average traffic volume from January to June of 2008, before the implementation of Weekday bus-only lane policy, we compared the monthly average traffic volume of 2007 and 2008. We set the traffic volume of the first half of 2007 and 2008 as a standard because Weekday bus-only lane system was implemented from July 2008. The result of analysis is in the table 2 and picture 2.

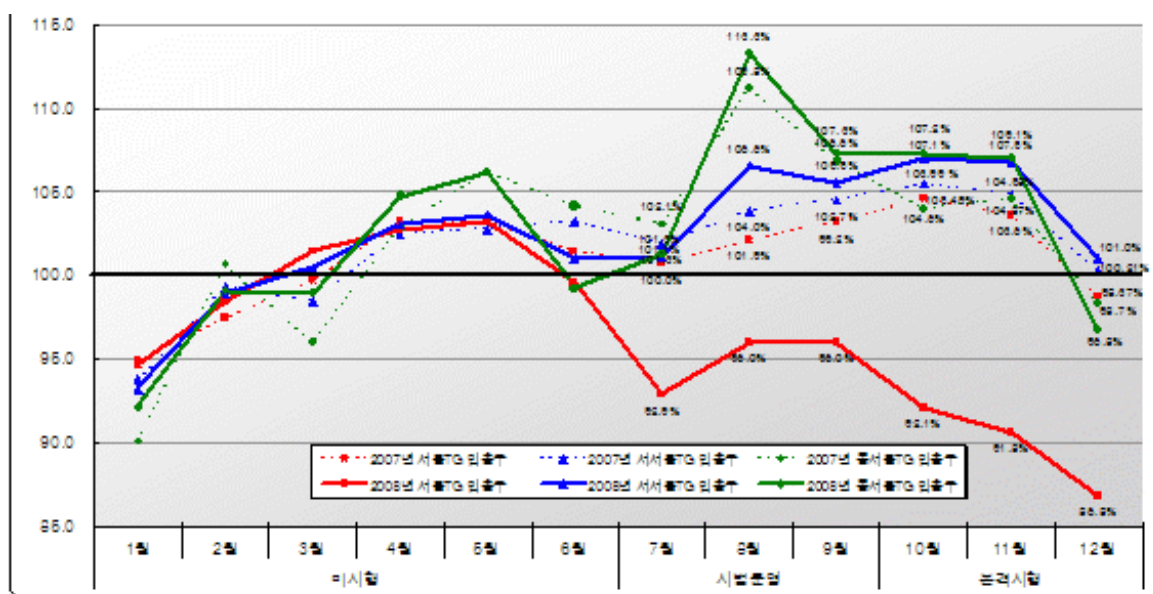


Figure 2. Monthly rate of average traffic volume based on the average volume of first half year

Table 2. Monthly rate of average traffic volume based on the average volume of first half year

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Seoul TG	2007	94.9	97.4	99.7	103.2	103.2	101.4	100.7	102.1	103.2	104.6	103.6	98.7	101.1
	2008	94.7	98.4	101.5	102.7	103.2	99.5	92.9	96.0	96.0	92.1	90.6	86.8	96.2
West Seoul TG	2007	93.7	99.3	98.4	102.5	102.8	103.3	101.9	103.9	104.5	105.5	104.9	100.2	101.7
	2008	93.2	98.9	100.4	103.0	103.6	101.0	101.1	106.5	105.5	107.0	106.8	101.0	102.3
East Seoul TG	2007	90.1	100.7	96.0	102.8	106.2	104.2	103.1	111.2	106.9	104.0	104.6	98.4	102.4
	2008	92.1	99.0	98.9	104.8	106.2	99.2	101.3	113.3	107.3	107.3	107.0	96.8	102.8

According to the analysis, the monthly average traffic volume of Seohaean Expressway and Jungbu Expressway were at the similar level but that of Gyeongbu Expressway was decreased rapidly.

In the case of Seohaean Expressway and Jungbu Expressway, the traffic volume of the second half of 2008 increased slightly but in the case of Gyeongbu Expressway, the volume decreased by 7.8% compared to the previous year and we can say that Weekday bus-only lane affected to this change. However, the volume increased in August and September slightly due to the summer holiday season. In addition, given that the system was implemented as a pilot project of bus-only lanes from July to September in 2008, there might be some violation of the system and it might contribute to the increased traffic volume in August and September in 2008.

From October, 2008, when the system was officially implemented, the traffic volume of Jungbu Expressway and Seohaean Expressway increased by 3.3% and 1.5% respectively compared to the previous year but that of Gyeongbu Expressway rapidly decreased by 12.5%. What is notable is that the traffic volume at TGs of Jungbu Expressway and Seohaean Expressway was higher than that of the previous year by 2.1% and 2.6% respectively in August. The main reason of this phenomenon is increased traffic volume due to the summer holiday season.

3) Change of passenger car volumes and the number of bus passengers

Analyses on the traffic volume and the traffic pattern was based on the total cars so that we needed to figure out how many passengers started to use buses connecting Gyeonggi province and Seoul after the implementation of Weekday bus-only lane policy. According to the analysis on the bus passenger numbers, the number of bus passengers has increased continuously and the driving speed of bus also increased. The number of bus passengers increased by 30.6% (58570 persons/day) on average after conducting the policy and this shows that many started to use public transportation after the implementation of the policy. There may be 3 reasons behind it.

First, the discount policy for bus transfer was expanded to red buses, so that the bus fare was dropped. Second, the red bus lines were reformed hugely, resulting in an enhanced quality of public transportation system. In fact, the number of bus lines increased from 29lines to 46lines after the reform. Finally, after the implementation of Weekday bus-only lane policy, the driving speed of bus increased and accuracy of buses was also enhanced. As a result, the quality of public transportation service was improved as a whole.

In addition, we compared the number of passenger cars on the road. To do so, based on the figures in the Seoul TG of Gyeongbu Expressway, we compared the number of passenger cars and all kinds of cars of each month from January to December of 2007 and 2008. We used TCS data collected by Korea Expressway Corporation.

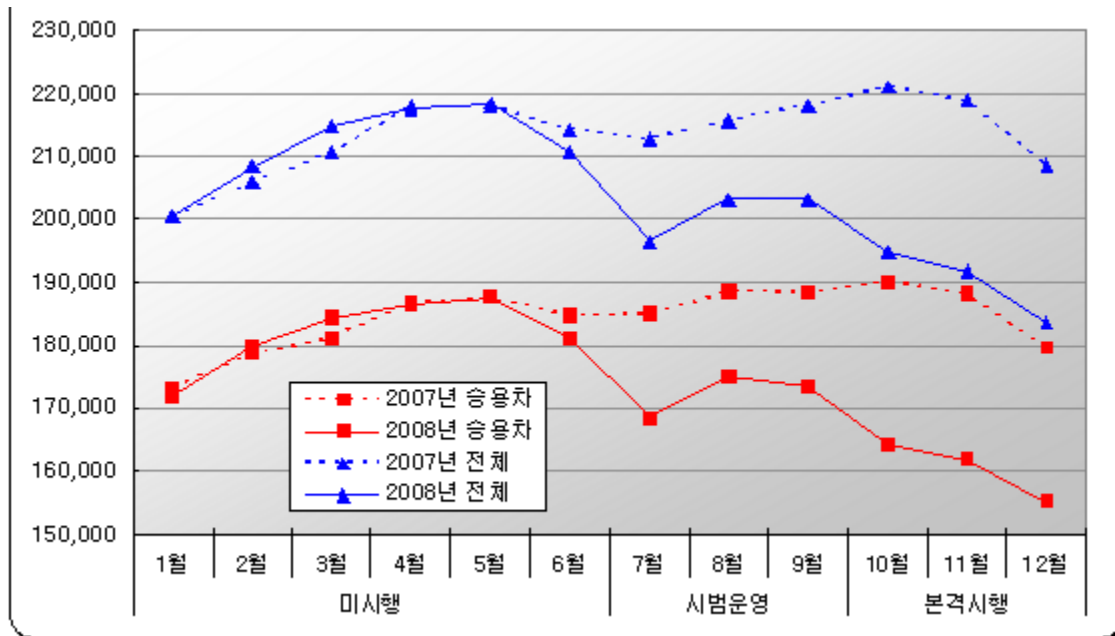


Figure 3. Number of passenger cars in the Seoul TG of Gyeongbu Expressway

According to the comparison, there was no difference between 2007 and 2008 in terms of the number of passenger cars and all kinds of cars before the implementation of Weekday bus-only lane policy but during the pilot project period, the number of passenger cars decreased by 8% compared to that of 2007 and when we started to conduct the policy officially, the number of passenger cars decreased by 13.72% and the total traffic volume decreased by 12.09% compared to that of 2007.

What is notable is that the number of passenger cars decreased due to the implementation of Weekday bus-only lane policy and the range of that decrease was relatively huge after the official implementation of the policy. The main reason of this huge change was that there were no crackdown on the use of bus-only lanes during it was a pilot project. After October, 2008, when the crackdown on the bus-only lane usage started, other lanes were congested due to bus-only lanes. Thus, many drivers detoured to other local road as well as national highways. Also some drivers might decide to use public transportation to avoid those kinds of traffic congestion caused by the implementation of the bus-only lane policy.

2. Change of traffic congestion patterns

1) Comparison of traffic congestion based on the CCTV data

This study monitored traffic delays and traffic jams after the implementation of Weekday bus-only lane policy in the Gyeongbu expressway while analyzing traffic volume in the expressway. To that end, we used CCTV located along the road from Osan to Hannam bridge of Han River. According to the monitoring, the

traffic congestion took place to Giheung before the implementation of the policy, to Osan during the pilot project, and to Ansong after implementing of the system. These results showed that the traffic congestion in the expressway became more severe after the implementation of the bus-only lane system. In the side to Busan, the traffic congestion occurred in Suwon reached to Shingal IC before the implementation of Weekday bus-only lane policy but the congestion reached to the Seoul TG after it.

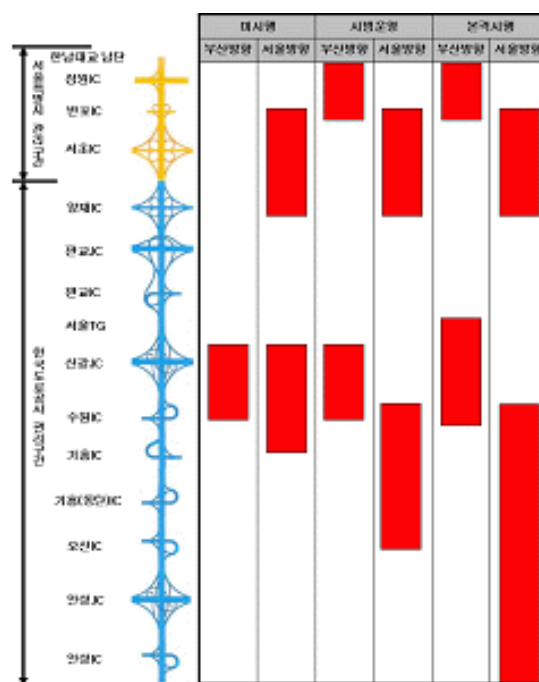


Figure 4. Change of traffic congestion patterns

According to the analysis, the traffic congestion in both sides of Gyeongbu expressway got severe much after the implementation of Weekday bus-only lane policy. In both sides, the congestion started to take place in Suwon. In the side to Seoul, the traffic congestion started at Suwon and reached to Osan and Ansong. In the side to Busan, the traffic congestion started at Suwon and reached to Shingal and to Seoul TG.

If we divide the bus-only lane implementation area into two sections; one is Seoul(Hannam- Yangjae) and the other is metropolitan area(Seoul TG- Ansong), the traffic condition of the Seoul area did not change much after conducting bus-only lane policy while that of the metropolitan area changed a lot. The main reason of this difference was that there was a bottleneck phenomenon in the metropolitan area.

Especially, when we take a look at the change of traffic congestion with the change of traffic volume, we can know that the traffic congestion got severe even though the total traffic volume decreased after the implementation of Weekday bus-only lane policy. It shows that even though the traffic volume decreased due to the figure, traffic congestion got more severe because we lost a lane for all vehicles except buses. In conclusion, the fact that the traffic volume at the Seoul TG decreased but the traffic congestion got more severe shows us that the inconvenience occurred by this policy is much bigger than the merit of it.

2) Analysis on the traffic congestion rate based on the traffic congestion data

We analyzed traffic condition of each section of the expressway briefly based on the CCTV data but we needed to have some exact figures to clarify the level of traffic congestions. To that end, we used FTMS traffic congestion data collected by Korea Expressway Corporation to identify traffic condition of the expressway. We used the traffic congestion data collected from January 2008, to the 23rd, December, 2008, to figure out the change based on the average traffic congestion calculation methods per time or per section. After the implementation of the bus-only lane policy in the Gyeongbu expressway, the time to analyze traffic conditions was from 6 A.M. to 10 P.M.

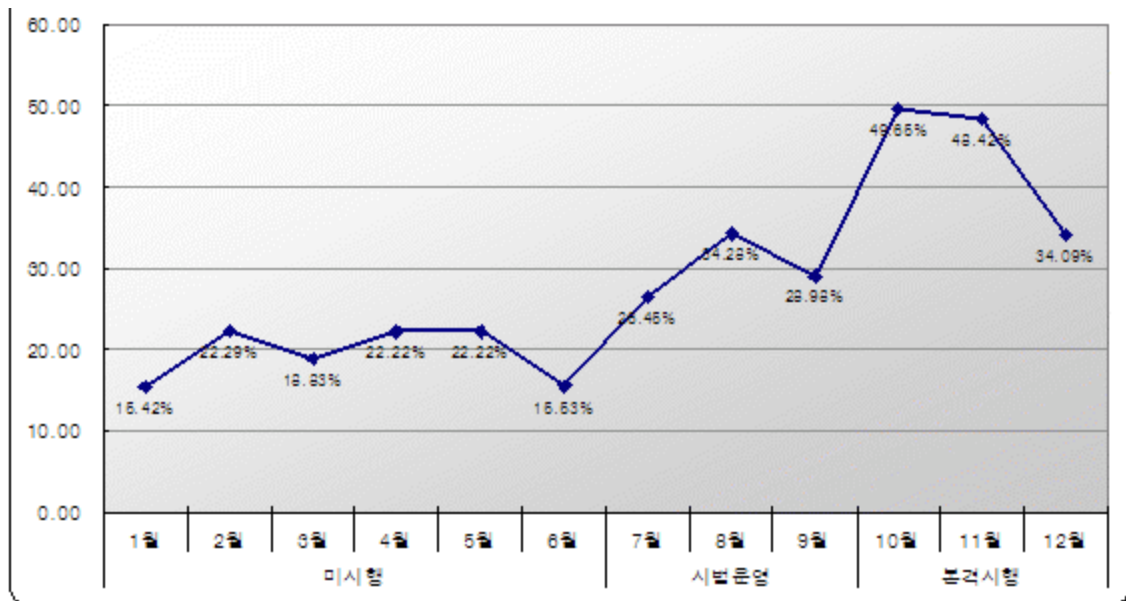


Figure 5. Change of traffic congestion rate

The traffic delay rate of Gyeongbu expressway was at 19.42% before implementing Weekday bus-only lane policy, but the rate increased to 29.9% during pilot project period, and increased to 44.1% after implementing the bus-only lane policy officially. This result showed that the traffic congestion of ordinary roadways got severe because of the car which couldn't use the bus-only lane. What is notable is that the traffic congestion rate has increased even though the traffic volume as a whole decreased.

Also, the traffic congestion rate of the expressway has decreased slightly since November, 2008. It may be because shoulder lanes are used in some sections of the Gyeongbu expressway to prevent possible traffic jams occurred by the implementation of bus-only lane policy. From Shingal IC to Jukjeon Highway service area, the driving speed of the section increased by 18.7 Km/h and the congestion length was shortened by 1.4Km. In other perspective, some can say that Weekday bus-only lane policy was settle after the transition period but we only had a monitoring period of 6months, so it's early to say that the policy was fully settled.

IV. Conclusion

This study was designed to understand the impacts of the introduction of Weekday Bus-only Lane on Gyeongbu expressway by monitoring changes in traffic. Findings were as follows: First, commuters were more likely to take buses as the public transportation system in Gyeonggi province was improved and the

bus-only lane allowed buses to arrive on time. Second, traffic congestion on other lanes worsened to slow down the speed of passenger cars. Even though traffic nearby Seoul tollgate was reduced, traffic jam in the metropolitan area (between Seoul tollgate and Anseong) got exacerbated. However, the situation is improving after the temporary use of a shoulder lane has been adopted as a short-term measure to address the congestion in the area.

As such, Weekday Bus-only Lane provides the benefit of better public transportation services, while worsening traffic jam on other lanes. However, the volume of passenger cars is clearly on the decline, suggesting that the congestion will be relieved if the Weekday Bus-only Lane policy is firmly established and more commuters switch to buses. Until now, the severity of traffic jam does not outweigh benefits offered by the bus-only lane, as shown before.

The monitoring in this study initiated when the pilot operation of the bus-only lane started and lasted for 6 months. It is believed that continuous monitoring is required to recognize traffic trend and take proper management measures, because traffic situation changes with newly-opened roads near Gyeongbu expressway and traffic management policies.

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